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(54) Flywheel and torsional vibration damper

(57) A torsional vibration damping device, for installation between an internal combustion engine and a gearbox with an input part 2 and output part 3 between which a damping device is provided in the torque transfer path a fitted or added-on flywheel mass formed by a sheet metal body 60. The sheet metal of the body is folded round at least once over practically a complete circular circumference so that sections of the sheet metal body exist which have at least two directly adjoining sheet metal layers.

Fig.1

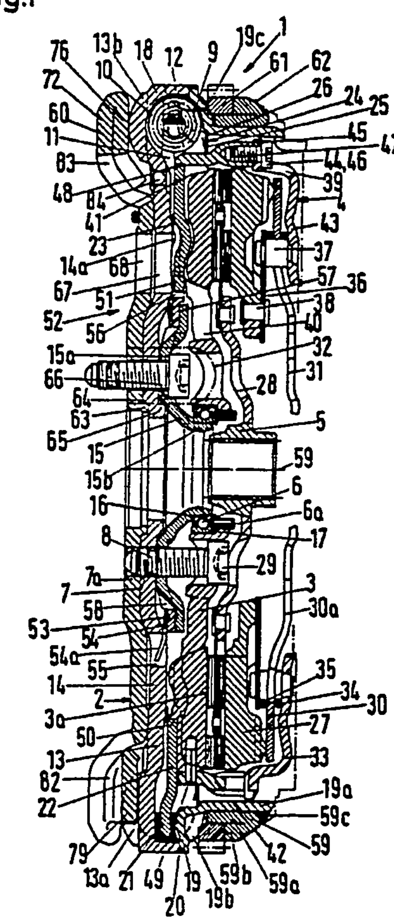

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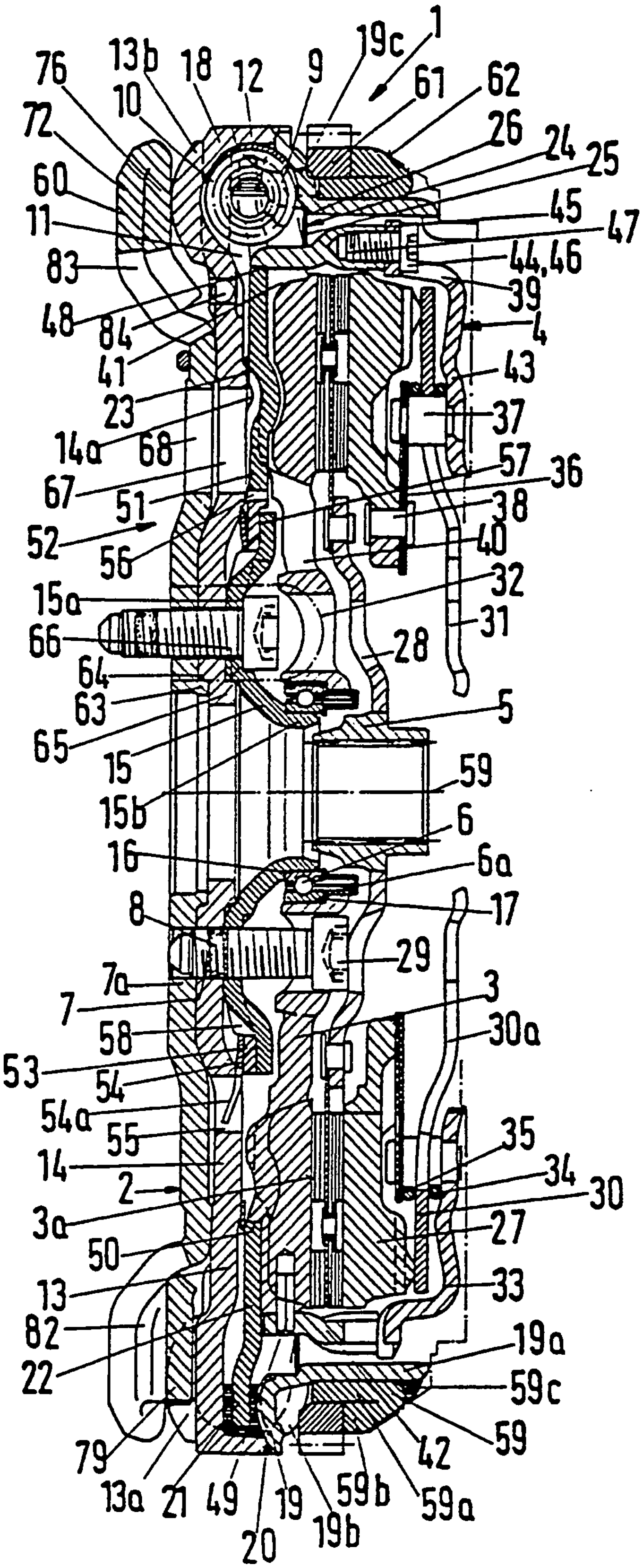
Fig.1



76
13b
18
12
9
19c
1
61
62
72
10
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24
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60
45
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11
44,46
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39
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41
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23
37
14a
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15a
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15b
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7a
3
7
30a
58
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54
54a
55
35
34
14
30
2
3a
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50
13
33
82
19a
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59c
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59
42
13a
21
49
19
59b
59a
20
19b

Fig.2

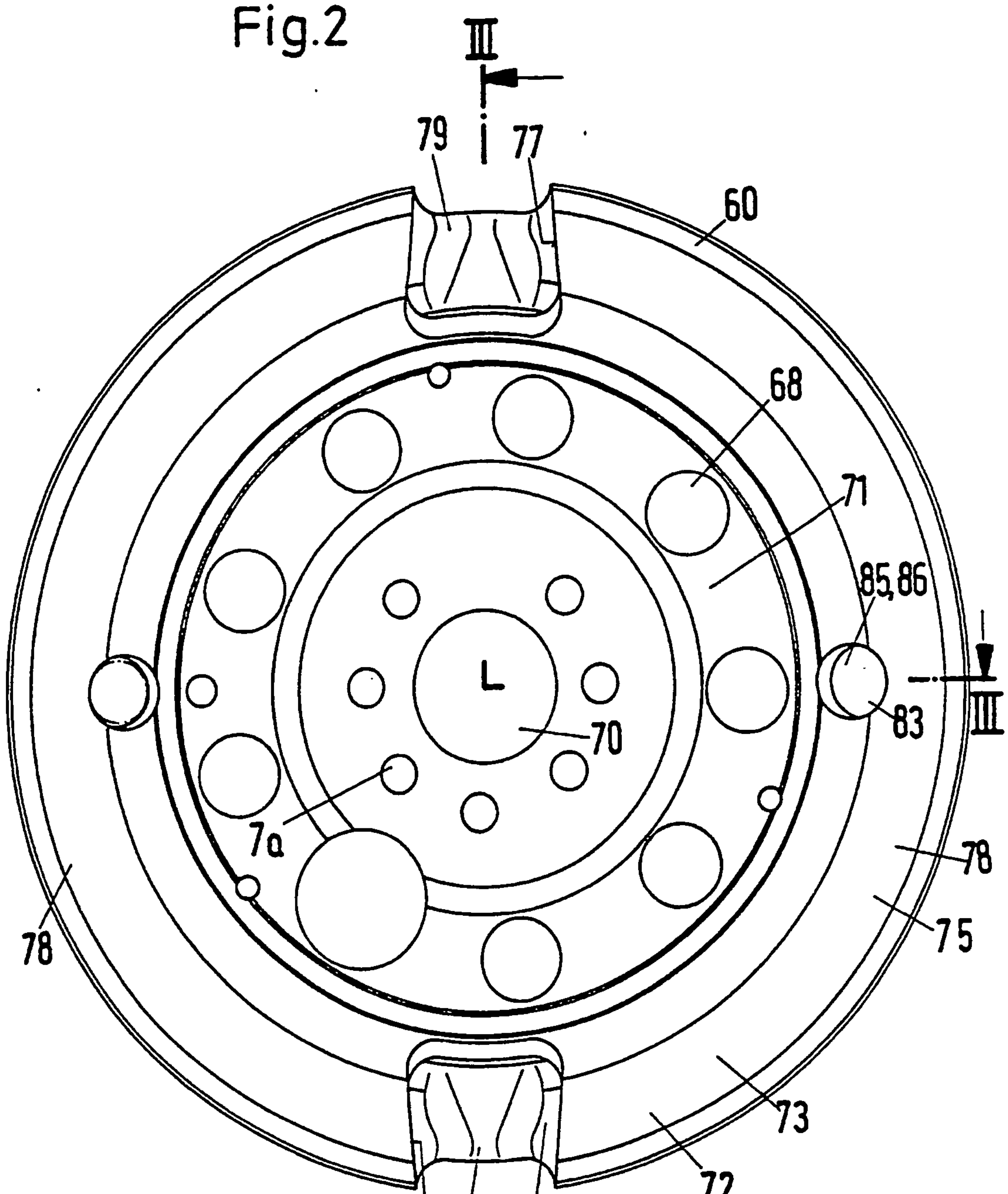


Fig.3

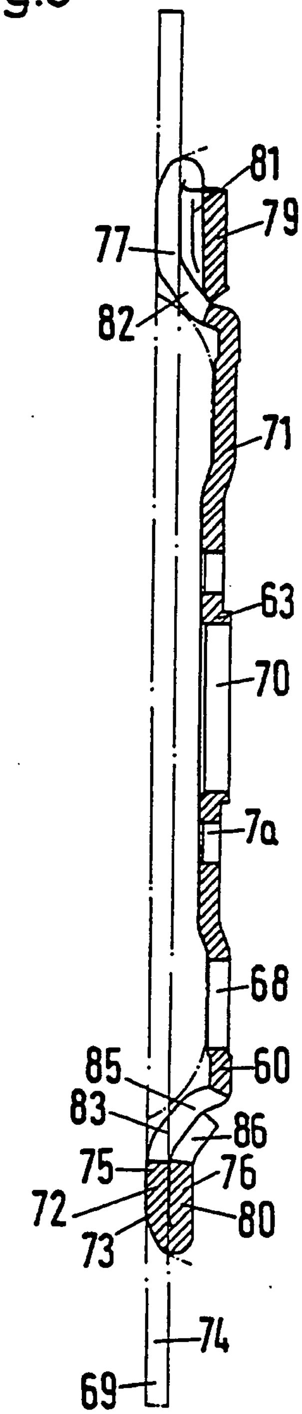
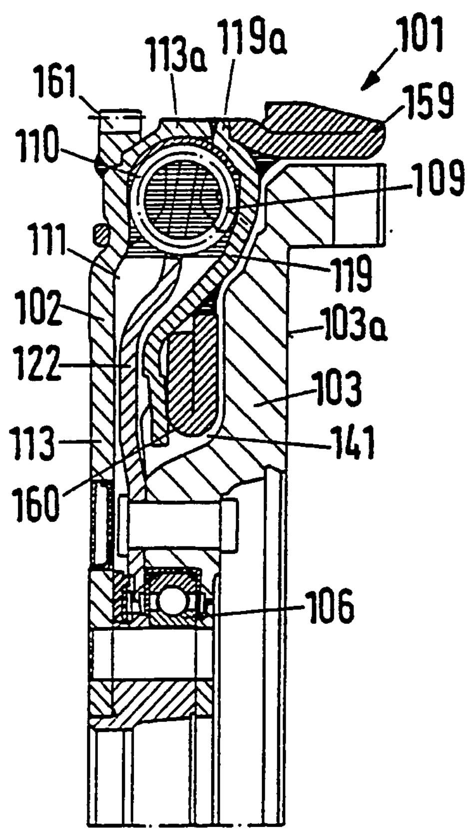


Fig.4



101
113a
119a
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119
102
103a
122
103
113
141
160
106

Fig.5

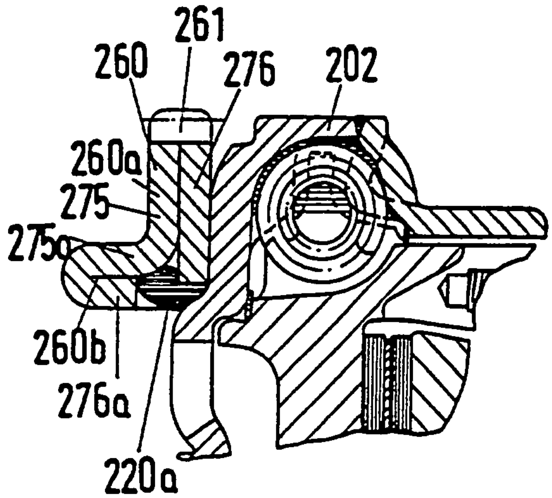


Fig.6

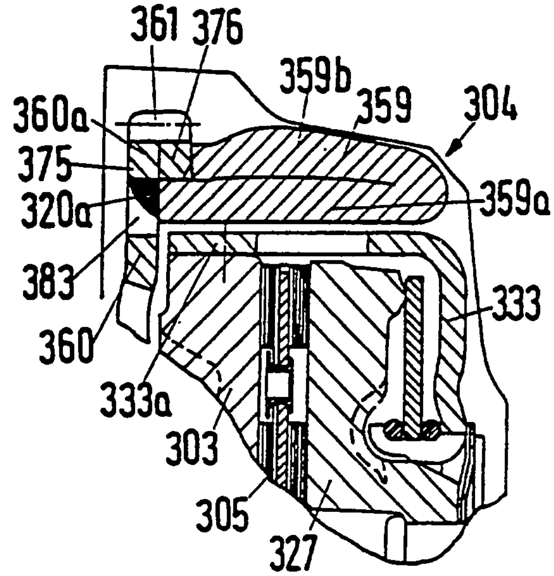


Fig.7

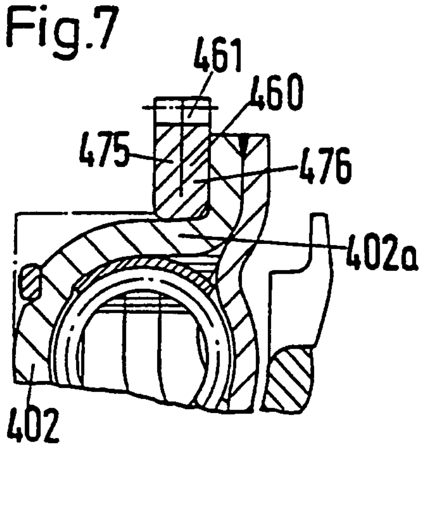
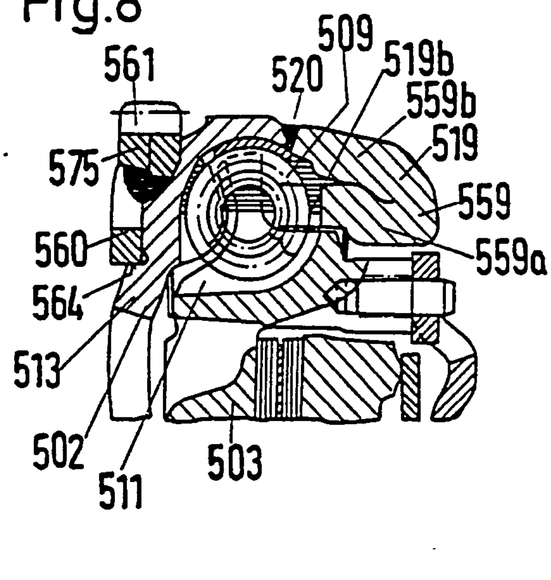


Fig.8



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Torsional vibration damping device

The invention relates to a torsional vibration damping device, more particularly for installation between an internal combustion engine and a gearbox, with an input part and an output between which a damping device is provided in the torque transfer path.

Torsional vibration damping devices of this kind are known for example from DE-OS 41 17 571. These devices have an input part, which can be connected for example with the crankshaft of an internal combustion engine, and an output part which is connectable with a gearbox. In order to obtain optimum filtering and damping of the torsion vibrations between the internal combustion engine and the gearbox the inertia moment of the device must have a minimum amount in order to be able to compensate at least partially the irregularities in the torque output of the internal combustion engine. To this end it is particularly advantageous if the input part connectable rotationally secured to the output shaft of the internal combustion engine has an increased mass inertia moment.

The object of the present invention is to provide torsional vibration damping devices whose mass inertia moment can be adapted to each case in a particularly simple and economic manner. Furthermore it should be possible through the invention to adapt the basic construction of a torsional vibration damping device to different uses and cases.

According to the invention this is achieved in that the torsional vibration damping device has a fitted, thus additional, flywheel mass formed by a sheet metal body wherein the sheet metal of the body is folded round at least once over practically a complete circular circumference so

that sections of the sheet metal body exist which have at least two directly adjoining sheet metal layers. Sheet metal bodies of this kind can be made particularly easily and economically by folding, bending or flanging over suitably designed sheet metal blanks. A multi-layered design of at least partial areas of the sheet metal body is also possible. Thus for example double, triple or multi-layered sections can be formed on the sheet metal body.

It can be particularly advantageous if the sheet metal body is supported by the input part of the torsional vibration damping device.

The additional flywheel mass formed by a sheet metal body can be made particularly easily and economically from an originally flat disc-like sheet metal blank, eg in the form of a metal slab.

It can be particularly expedient if the at least double-layered sheet metal body sections have a smaller radial extension than the sheet metal body itself and are provided radially outside on same. Through such a design the mass inertia moment of the sheet metal body can be formed particularly large wherein the sections provided radially inside the multi-layered sheet metal body sections can be used for further functions, such as for example for ventilation and/or fixing the sheet metal body on another component. The arrangement of the mass formed by a multi-layered design of a sheet metal body section on an outer comparatively large diameter has the additional advantage that the mass inertia moment of the device can be considerably increased without increasing the weight of the device out of proportion or to a considerable extent. The multi-layered sheet metal body sections can be formed particularly easily by radially folding over radially outer

areas of an originally flat sheet metal blank.

It can be particularly advantageous if the individual layers of the sheet metal body sections adjoin one another at least approximately, thus contact one another in practice. In many cases it can be advantageous if the individual layers of the sheet metal body sections run substantially radially, in other cases however the individual layers can also run advantageously at least substantially in the axial direction. It can be particularly advantageous if the individual layers of the sheet metal body or the sheet metal body sections are aligned so that they ensure optimum filling up of the remaining structural spaces and free spaces which remain between individual components of the device or between the device and the adjoining components, such as eg the clutch bell of the gearbox.

It can be particularly expedient if in the case of a torsional vibration damping device which is housed in a housing, at least the folded areas of the sheet metal body match at least substantially the contours of the boundary faces of the housing - whilst observing a slight air gap -.

The invention can be used particularly advantageously in so-called twin-mass flywheels which have a flywheel element which can be coupled with the internal combustion engine, and a flywheel element connectable with the gearbox wherein the two flywheel elements can be rotated relative to each other by a bearing. The first flywheel element forming the input part of the torsional vibration damping device can thereby define a chamber which is filled at least in part with a viscous medium and houses the springs.

A particularly advantageous design of the torsional vibration damping device can thereby be produced in that the

of the internal combustion engine. The axially off-set sheet metal body section can thereby form or define at least one radial aperture which can be formed for example by cutting free the non-folded layer. In order to increase this aperture the inwardly folded layer can be set back axially in the area of the free cut towards the disc-like inner area whereby the folded layer has at least one axial indentation. According to a further possibility for designing the sheet metal body according to the invention this sheet metal body can have axially aligned sheet metal layers and can be fixed radially outside on the first flywheel element. The sheet metal layers serving to increase the mass inertia moment can thereby extend axially over the second flywheel element and enclose this in the circumferential direction. With such a design the second flywheel element can be provided or housed radially inside the sheet metal body.

According to a further development of the invention at least parts of the multi-layered sections of the sheet metal body can undertake further functions, thus for example in particular a toothed structure can be formed on the radially outer areas of the multi-layer sections so that the sheet metal bodies can undertake the function of a starting gear ring. The toothed structure can however also be designed so that it can be used as marking or impulse trigger for an engine management system so that for example the ignition and/or fuel supply and where applicable further functions required for operating the internal combustion engine can be controlled or adjusted by the sheet metal body according to the invention. The sheet metal body according to the invention can also have a moulded-on starting gear ring and markings for the engine management system wherein the toothed structure or markings need not be provided absolutely in the area of the multi-layer sections of the

sheet metal body.

According to a further possibility of designing the invention the first flywheel element can have a first wall which is connectable with the internal combustion engine , runs substantially radially and supports radially outside a second wall which together with the first wall defines a chamber filled at least partially with a viscous medium wherein the second wall extends radially inwards in the axial structural space between the first wall and the second flywheel element whilst forming a free space between the second wall and the second flywheel element wherein this free space is mounted radially inside the energy accumulator of the damping device contained in the chamber and contains a mass body made of sheet metal and connected to the second wall.

The invention will now be explained with reference to the drawings in which:

Figure 1 is a sectional view through a torsional vibration damping device according to the invention;

Figure 2 is a view of an additional mass according to the invention;

Figure 3 is a sectional view along the line III-III of Figure 2; and

Figures 4 to 8 are partial sectional views of further devices designed according to the invention.

Figure 1 shows a divided flywheel 1 which has a first or primary flywheel mass 2 fixable on a crankshaft (not shown) of an internal combustion engine, as well as a second or secondary flywheel mass 3. A friction clutch 4 is fixed on this second flywheel mass 3 with the interposition of a clutch disc 5 through which a gearbox (likewise not shown)

can be engaged and disengaged. This clutch disc 5 is shown here as being of rigid construction and only serves as example. Thus this clutch disc 5 can also include by way of example further structural shapes, can contain the damping and/or friction elements or can also be fitted with a lining suspension.

The flywheel masses 2 and 3 are mounted rotatable relative to each other by a bearing 6 which in this embodiment is mounted radially inside the bores 7 for passing through the fixing screws 8 used for fitting the first flywheel mass 2 on the output shaft of an internal combustion engine. The single-row ball bearing 6 shown here has a sealing cap 6a with a lubricant supply chamber wherein the sealing cap 6a serves simultaneously as the heat insulation between the flywheel mass 3 and the bearing 6 by preventing a heat bridge. A damping device 9 acting between the two flywheel masses 2 and 3 has coil compression springs 10 which are mounted in a ring-like chamber 11 which forms a toroidal area 12. The ring-like area 11 is thereby filled at least partially with a viscous medium, such as for example oil or grease.

The primary flywheel mass 2 has a component 13 which can preferably be made or drawn from sheet metal material. The component 13 serves to fix the first flywheel mass 2 or the entire divided flywheel 1 on the output shaft of an internal combustion engine and supports the ring-like space 11 in a radially outer area. The component 13 forms a substantially radially aligned flange-like area 14 which supports radially inwards a support flange 15 whose radial areas 15a have bores aligning with the recesses 7 for the fixing screws 8. The single-row rolling bearing 6 is set with its inner ring 16 on an outer support shoulder in the axial end section 15b of the support flange 15. The outer ring 17 of the rolling

bearing of the bearing 6 supports the second flywheel mass 3. To this end the flywheel mass 3 has a central recess which is suitable for holding the rolling bearing 6 together with the sealing cap 6a.

The substantially radially aligned area 14 changes radially outwards into an area 18 which extends axially away from the internal combustion engine, defines the toroidal area 12 radially towards the outside and engages at least partially axially over and circumferentially round the energy accumulator 10 at least over its length to guide and radially support same. At its end remote from the internal combustion engine the area 18 of the sheet metal body 13 supports a body 19, likewise made preferably from sheet metal, which extends first radially inwards starting from the area 18 and which has radially inside an axial attachment 19a. The body 19 likewise serves to form and demarcate the toroidal area 12 and to guide the spring 10. With the illustrated embodiment the area 18 extends over the larger part of the axial extension of an energy accumulator 10. The body 19 is connected to the sheet metal body 13 by a welding seam 20 and has a section or sleeve-like wall section 19a extending substantially axially away from the component 13. The toroidal area 12 formed by the body 19 and area 18 of the sheet metal body 13, viewed circumferentially, is divided into individual sockets in which the energy accumulators 10 are provided. These individual sockets are, again viewed circumferentially, separated from each other by biasing areas for the energy accumulators which can be formed by axial deformations or pockets 13a, 19b imprinted in the sheet metal part 13 and body 19. The sockets for the springs 10 are formed by indentations 13b, 19c formed in the sheet metal parts 18 and 19.

The biasing areas 21 provided on the second flywheel mass 3 for the energy accumulators 10 are formed by at least one biasing member 22 connected to the secondary flywheel mass 3 and serving as a torque transfer element between the energy accumulators 10 and the flywheel mass 3. The biasing member 22 has radial extension arms 21 which are mounted spread out over the circumference corresponding to the spring assembly and which in the rest state of the flywheel 1, thus when no torque is being transferred, are located directly between the biasing areas 13a, 19b of the sheet metal part 13 and the body 19. The biasing member 22 is formed by a separate ring-like part 22 which is attached centred to the secondary flywheel mass 3.

Two seals 23 and 24 are provided in order to seal the ring-like chamber 11 which is filled partially with viscous medium. In the illustrated embodiment the seal 23 is formed circular ring-shaped and is made in one piece. The seal 23 is held centred in its radially inner area on at least one axial attachment 14a of the flange-like area 14 and extends from there radially outwards into the axial interspace which is defined axially by the substantially radially aligned area 14 of the component 13 and the face of the secondary mass 3 remote from the friction face 3a or by areas of the biasing member 22. The seal 23 is designed like a Belleville spring and is axially resiliently tensioned between the sheet metal part 13 and the secondary flywheel mass 3 or the part 22 connected to same.

The second sealing assembly 24 is divided in two parts and consists basically of a component 25 with L-shaped cross-section and an axially resilient element, such as a Belleville spring 26. The Belleville spring 26 is supported by its radially outer area on the side of the wall of the sheet metal body 19 facing the toroidal area 12 and with its

radially inner area biases the sealing component 26 towards the component 13.

Together with the clutch unit comprising the clutch 4 and clutch disc 5 the twin-mass flywheel 1 forms one structural unit which is preassembled, despatched and stored as such and which can be fitted in a particularly simple rationalized way on the crank shaft of an internal combustion engine since through this design various processing steps are dispensed with, such as for example the otherwise necessary centring process for the clutch disc, the work step for fitting the clutch disc, the mounting of the clutch, the insertion of the centring pin, the centring of the clutch disc itself as well as where applicable the insertion of the screws and the screwing on of the clutch and the removal of the centring pin.

The fixing screws 8 can be already prefitted or contained in the bores of the flange area 14 and of the support flange 15 where they are preferably held in a secured position, for example by pliable means which are dimensioned so that their retaining force is overcome as the screws 8 are tightened.

The clutch disc 5 is tensioned in a position pre-centred relative to the axis of rotation of the unit between the pressure plate 27 and friction face 3a of the secondary flywheel mass 3 and furthermore in such a position that the openings 28 provided in the clutch disc 5 are located in such a position that when the assembly or structural unit is fixed on the output shaft of an internal combustion engine it is possible for the screwing tool to pass through. Furthermore deviating from the illustrated embodiment the openings 28 can be smaller than the heads 29 of the screws 8 so that a satisfactory secured hold of the screws 8 inside the unit is ensured.

Cut-out sections or openings 31 are also provided in the Belleville spring 30 in the area of the tongues 30a for the screwing tool. The cut-out sections 31 can thereby form expansions or enlarged areas of the slits which are present between the tongues 30a. The openings 31 in the Belleville spring 30, 28 in the clutch disc 5 and 32 in the flywheel mass 3 thereby align with one another in the axial direction and thus through their axial alignment allow an assembly tool to pass through to tighten up the screws 8 and thus to fix the assembly on the crankshaft of an internal combustion engine.

The clutch 4 which can be operated by the Belleville spring 30 has on one side on the clutch cover 33 a swivel support pad 34 on the cover side and a swivel support pad 35 on the side remote from the cover. On the side of the swivel support pad 35 remote from the cover 33 there is a leaf spring element 36 which together with the two swivel support pads 34, 35 and the Belleville spring 30 is connected by rivets 37 to the substantially radially aligned section of the clutch cover 33. The leaf spring elements 36 are connected by rivets 38 to the pressure plate 31 in an area which is mounted radially inside the friction linings of the clutch disc 5.

Next to the recesses 32 in the flywheel mass 3 and 28 in the clutch disc 5 there are also further openings or ports 39 in the area of the clutch cover 33 and 40, 41 in the flywheel mass 3 which serve to cool the overall assembly unit. By sufficiently cooling the overall assembly unit it is possible to prevent inter alia the paste-like medium such as grease contained in the toroidal area 12 from heating up unduly whereby the viscosity of the medium can be lowered so that it becomes fluid. Furthermore an increased thermal strain has a negative effect on the overall service life of

the structural unit.

The clutch cover 33 which is fixedly connected to the secondary flywheel mass 3 consists substantially of the axial area 42, which is formed substantially like a hollow cylinder, and the at least substantially radially aligned section 43 wherein these two parts 42 and 43 are fixedly connected together by a screw connection 44. To this end the clutch cover part 43 has in its radially outer area flange-like radially extending sections 45 through which the fixing screws 46 extend in the axial direction and against which these can be placed with their heads. With their threads the screws 46 are anchored in the recesses 47 which are formed by splitting the sheet metal material of the axial section facing the clutch cover part 43 of the substantially axially extending hollow cylindrical part 42.

The ring-like component 22 supporting the radial arms 21 is rigidly connected to the cylindrical part 42 by welded connections 48. The part 42 engages axially over the secondary flywheel mass 3 and is fixedly coupled with this in both the axial and rotary directions by pin connections 49. Radially inside, the ring-like part 22 is set centred on a shoulder 50 of the secondary flywheel mass 3. The ring-like part 22 has furthermore radially inside extension arms 51 which serve to control a friction device 52 designed as a load friction device. The friction device 52 has a friction ring 53 and a Belleville spring 54 which is axially tensioned between the friction ring 53 and the radial sections of the area 14. The Belleville spring 54 has extension arms 54a which extend radially outwards and engage in recesses 55 in the radial area 14 of the component 13 for security against rotation. The extension arms 51 of the ring-like component 22 engage with circumferential play in recesses 56 of the friction ring 53. The radial area 15a of

the support flange 15 is made into a plate radially outside of the fixing screws 8 in the direction of the secondary flywheel mass 3 so that between the radially aligned outer ring-like section 57 of the radial support flange area 15a and the radial inner area 14 of the component 13 an axial free space is formed in which the friction ring 53 and Belleville spring 54 are housed. Radially inside the friction ring 53 the support flange 15 has axial indentations 58 which form at least one centring shoulder for the friction ring 53.

In order to increase the mass inertia moment of the twin-mass flywheel 1 turning about the rotational axis 59 the primary flywheel mass 2 which can be coupled with an internal combustion engine has two components 59, 60 which increase the mass inertia.

The component 60 is formed by a sheet metal body which has two axially pointing arms 59a, 59b which in the illustrated embodiment adjoin one another directly in the radial direction. The radially inner arm 59a is set on the axial attachment 19a of the component 19 and is connected with this by at least one welded connection 59c. The radially inner arm 59a is formed longer than the radially outer arm 59b and holds a starting gear ring 61 on the areas protruding axially relative to the arm 59b. The starting gear ring 61 is housed axially between the end side of the outer arm 59b and the indentations 19c of the component part 19.

The ring-like sheet metal body 59 is formed from an originally flat ring-like sheet metal blank which was shaped by axially folding round a radially outer and a radially inner area about a radially interposed folded section to form a hollow cylindrical body 59. With this designing or

shaping the contours of the sheet metal body 59 can be adapted to the inner sleeve contours of the housing holding the twin-mass flywheel, such as in particular the gearbox bell so that no contact can take place. To this end with the embodiment according to Figure 1 a flattened area 62 designed as a frusto-conically aligned surface is formed on the sheet metal body 59. The material displaced by attaching the flattened area 62 was used to increase the material thickness of the outer arm 59b. The additional mass designed as the ring-like sheet metal body 59 is located at least approximately level radially with the springs 10. In the illustrated embodiment the mass formed by the sheet metal body 59 has only two sheet metal layers which form the axially aligned arms 59a, 59b. It is however also possible by repeatedly folding round a flat disc-like or ring-like sheet metal blank to form a mass with a number of layers, thus for example three, four, or more layers. The shaping can be carried out so that the individual layers run at least partially in the radial direction instead of extending in the axial direction.

The additional mass 60 likewise formed as a sheet metal body 60 is provided on the side of the component 13 facing the internal combustion engine which (component) transfers the torque from the internal combustion engine to the second flywheel mass 3 through the interposition of the damping device 9. The two extra masses 59 and 60 are thus in practice supported by the input part of the damping device 9 connectable with the internal combustion engine and are thus connectable practically rigid with the output shaft of the internal combustion engine.

The sheet metal body 60 thus has substantially the same radial extension as the component 13 and to minimize the axial space required is adapted or conforms at least

substantially to the contours of the component 13. Radially inside the sheet metal body 60 has an axial attachment 63 pointing in the direction of the component 13 and engaging in an indentation 64 of the component 13 for central positioning. The component 13 likewise has radially inside an axial attachment 65 on which the support flange 15 is centred by an inner step 66. In the radially inner areas the component 60 which is designed as a shaped sheet metal part has recesses 7a aligned axially with the recesses 7 of the part 13 to hold the screws 8. Radially between the screws 8 and the springs 10 there are recesses 67,68 which coincide axially in the component 13 and in the sheet metal body 60 and which serve to create an air circulation to improve the cooling of the twin mass flywheel 1. The sheet metal body 60 is formed by shaping round and cutting out areas from an originally flat sheet metal plate or sheet metal web. It can be particularly advantageous if in order to make a sheet metal body 60 a disc-like flat slab 69 is used which was cut out from a flat sheet metal material.

As can be seen from Figures 1 to 3 the sheet metal body 60 has a central recess 70 which is enclosed by a substantially radially aligned ring-like area 71. The recesses 68 and 7a are formed in this ring-like area 71. Radially outwards the ring-like area 71 changes into a circular ring-like section 72 which is axially off-set in the direction of the internal combustion engine or in the direction away from the component 13 relative to the inner ring-like area 71 whereby the component 60 has a plate-like shape. The ring-like section 72 has radially aligned areas 73.

As can be seen in particular from Figure 3, the radially outer sections 74 of the starting slab 69 are folded round or back inwards so that the outer ring-like section 72, viewed over its radial extension is formed at least

partially with two layers whereby the mass inertia moment of the sheet metal body 60 is increased. The two sheet metal layers 75 and 76 thereby contact one another axially at least substantially wherein the sheet metal layer 76 formed by folding round adjoins the component 13. As can be seen in particular from Figure 1 the layering of the component 60 is designed so that the ring-like outer section 72 conforms at least substantially to the indentations 13b of the component 13 wherein the folded round areas 76 can practically adjoin the indentations 13b. The double-layered section 72 is located substantially level radially with the damping device 9.

As can be seen from Figures 2 and 3 the folded round layer 76, viewed over the circumference, is closed, thus cohesive whilst the adjoining sheet metal layer 75 has cut out sections 77 which extend over the entire radial extension of the folded round sheet metal layer 76 and are diametrically opposite one another. The sheet metal layer 75 of the outer section 72 is thereby divided into circular ring sectors 78. As can be seen from Figure 3 the sections 79 of the folded round layer 76 running in the area of a cut-out section 77 are off-set relative to the remaining sections 80 axially away from the sheet metal layer 72 whereby axial indentations 81 are formed. The off-set sections 79 are thereby arranged, as can be seen from Figure 1, so that , viewed in the circumferential direction of the component they engage axially between indentations 13b to hold energy accumulators 10 and are thus axially adjacent to the biasing areas 13a. As can be seen in particular from Figures 1 and 3 radial ports 82 are formed through the sections 77 and the axially indented sections 79 and can serve to pass through a tool, eg for screwing on a component when the flywheel 1 is mounted on the internal combustion engine.

partially with two layers whereby the mass inertia moment of the sheet metal body 60 is increased. The two sheet metal layers 75 and 76 thereby contact one another axially at least substantially wherein the sheet metal layer 76 formed by folding round adjoins the component 13. As can be seen in particular from Figure 1 the layering of the component 60 is designed so that the ring-like outer section 72 conforms at least substantially to the indentations 13b of the component 13 wherein the folded round areas 76 can practically adjoin the indentations 13b. The double-layered section 72 is located substantially level radially with the damping device 9.

As can be seen from Figures 2 and 3 the folded round layer 76, viewed over the circumference, is closed, thus cohesive whilst the adjoining sheet metal layer 75 has cut out sections 77 which extend over the entire radial extension of the folded round sheet metal layer 76 and are diametrically opposite one another. The sheet metal layer 75 of the outer section 72 is thereby divided into circular ring sectors 78. As can be seen from Figure 3 the sections 79 of the folded round layer 76 running in the area of a cut-out section 77 are off-set relative to the remaining sections 80 axially away from the sheet metal layer 72 whereby axial indentations 81 are formed. The off-set sections 79 are thereby arranged, as can be seen from Figure 1, so that , viewed in the circumferential direction of the component they engage axially between indentations 13b to hold energy accumulators 10 and are thus axially adjacent to the biasing areas 13a. As can be seen in particular from Figures 1 and 3 radial ports 82 are formed through the sections 77 and the axially indented sections 79 and can serve to pass through a tool, eg for screwing on a component when the flywheel 1 is mounted on the internal combustion engine.

The component 60 has further axial ports 83 which serve as access to openings 84 which are formed in the component 13 in the radial area of the ring-like chamber 11. The openings 84 serve to fill the ring-like chamber 11 with a viscous medium and are closed after this chamber is filled, eg by pressing in a ball. In order to form the axial ports 83 corresponding cut-out sections 85, 86 are formed in the sheet metal body 60 or in the sheet metal layers 75,76.

The cut-out sections 77, 85 and 86 as well as if required the recesses 68 can advantageously be formed in the flat starting slab 69. The screw bores 7a are preferably formed in the component 60 after shaping the sheet metal part 60, thus after the folding operations, deep drawing operations and imprinting operations so that a satisfactory positioning of the recesses 7a is provided relative to the imprint 63 which ensures the centring relative to the component 13.

In many vehicles the already mentioned radial ports or openings 82 allow the oil sump to be fitted after fitting the flywheel 1 on the output shaft of an internal combustion engine.

A high resistance against the effects of centrifugal force is guaranteed through the circumferentially closed design of the folded areas or sheet metal layer 76. It is thereby ensured that even at high speeds the folded-round layer 76 does not open, thus is not bent up radially outwards.

In the illustrated embodiment the radially outer ring-like section 72 is designed with only two layers. However this ring-like section can have more than two layers in order to increase the inertia moment of the component 60 and to adapt to the structural space available wherein forming the outer area of the starting slab 69 can also be carried out so that

the folded-round sections of the slab 69 form both radially and axially aligned areas. This forming or folding is carried out so that the contours of the existing structural space are utilized to the full extent.

The twin-mass flywheel 101 shown in part in Figure 4 has a primary flywheel mass 102 and a secondary flywheel mass 103 which are rotatable relative to each other by a bearing 106 against the action of the damping device 109. The ring-like chamber 111 which also holds inter alia the energy accumulators 110 of the damping device 109 is defined by a disc-like component 113 and a component 119 connected therewith. Axially between the two components 113, 119 is a flange body 122 which transfers the torque between the energy accumulators 110 and the secondary flywheel mass 103. The two components 113, 119 form radially aligned walls which have areas 113a, 119a directed radially outwards towards each other and connected together. The areas 113a and 119a engage axially over the energy accumulators 110. The wall formed by the component 119 extends radially into the axial free space between the secondary flywheel mass 103 and the flange body 122. The component 119 is thereby designed so that it forms a plate or dish axially away from the axially adjoining areas of the secondary flywheel mass 103 so that at least in the area of the friction face 103a of the flywheel mass 103 there is an axial free space 141 formed between the radially aligned areas of the component 119 and the flywheel mass 103. This free space 141 houses a ring-like component 160 which is fixedly connected to the wall 119 and serves to increase the inertia moment of the primary flywheel mass 102. The component 160 is made from sheet metal and is designed in two layers by folding round the radially inner areas of a circular ring-shaped starting slab. The folded sections of the starting slab have thereby been bent round at least approximately 180 degrees.

The primary flywheel mass 102 furthermore supports radially outwards a further mass body 159 which was made in a similar way to the mass body 59 according to Figure 1 and engages axially over and circumferentially round the secondary flywheel mass 103. In the embodiment according to Figure 4 the starting gear ring 161 is provided on the side of the primary flywheel mass 102 remote from the ring-like or sleeve-like mass body 159.

Sheet metals with a thickness in the order of between 3 and 7 mm are suitable for manufacturing mass bodies for increasing the mass inertia moment of the flywheel 1, 101, more particularly of the primary flywheel 2, 102.

With the embodiment according to Figure 5 the moulded sheet metal part 260 fixed on the first flywheel mass 202 forms a ring-like component with L-shaped cross-section. The shaped sheet metal part 260 is thereby designed so that both the radially aligned arm 260a and the axially aligned arm 260b have two sheet metal layers at least substantially over their entire extension, thus are designed double-layered. The axial arm 260b is aligned so that it points axially away from the first flywheel mass 202. The individual layers 275a, 276a of the arm 260b adjoin one another and are formed by folding over a radially inner circular ring-like area of the starting material. The outer layer 275a was bent round approximately 90 degrees. The inner layer 276a is bent back or folded onto the layer 275a. The individual layers 275, 276 forming the radial arm 260a adjoin one another axially and are connected together radially outwards. The arm 276 adjoining the primary flywheel mass 202 was formed by folding a radially outer circular ring-shaped section around approximately 180 degrees radially to the inside, namely in a similar way to that described in connection with the sheet metal layer 76 of Figure 3. Profiled areas 261 are formed

on the radially outer area of the radial arm 260a. These profiled areas 261 can form gearing for starting up the internal combustion engine.

The shaped sheet metal part 260 is connected radially inwards to the primary flywheel mass 202 by at least one welded connection 220a.

Figure 6 shows a detail of a friction clutch 304. The friction clutch 304 has a support plate 360 which is connectable with the output shaft of an internal combustion and which has radially outwards a multi-layered section 360a which is double-layered in the illustrated embodiment. Profiled areas 361 which can serve as the starting gear ring are formed on the radially outer areas of the section 360a. The actual clutch consisting of at least the counter pressure plate 303, clutch cover 333, pressure plate 327 and Belleville spring 330 is fixed on the support plate 360.

Radially outside the support plate 360 holds a mass body formed by a sheet metal body 359 and having two axially aligned arms 359a, 359b. The mass body 359 is made in a similar way to that described in connection with the mass body 59 according to Figure 1. The sheet metal body 359 extends axially over the counter pressure plate 303, the clutch disc 305 and at least partially over the pressure plate 327 and engages round at least these components in the circumferential direction. Furthermore the sheet metal body 359 engages round the axially extending area 333a of the clutch cover 333. The radially inner arm 359a of the sheet metal body 359 is centred on the support plate 360 by the inner sleeve face of the radially inwardly folded arm 376 and is connected with the arm 375 or support plate 360 by welded connections 320a. In order to produce the welded connections the support plate 360 which is made as a shaped

sheet metal part has axial ports 383 in the radial area on which the arm 359 is located.

With the embodiment according to Figure 6 the support plate or shaped sheet metal part 360 and the additional mass 359 formed by folding the sheet metal are designed in two parts. These two parts could however also be formed by one integral component. Thus for example the folded arm 376 of the shaped sheet metal part 360 could pass integrally into the radially inner arm 359a or the radially outer arm 359b of the component 359.

In Figure 7 a starting gear ring 461 formed by a shaped sheet metal part 460 is fitted on axially aligned outer areas 402a of the primary flywheel mass 402. The two radially aligned arms 475, 476 are connected together radially inwards in one piece and have the starting gear ring 461 moulded on to its radially outer free ends.

Figure 8 shows a shaped sheet metal part 560 which is designed similar to the radially outer areas of the support plate 360 according to Figure 6. The shaped sheet metal part 560 is welded to a wall 513 which with its radially outer areas defines a ring-like chamber 511. Energy accumulators 509 are housed in the chamber 511 in a similar way to that already described in connection with Figure 1. The shaped sheet metal part 560 which is formed with double layers radially outwards and with a starting gear ring 561 is centred by the radially inwardly longer arm 575 on a shoulder 564 of the wall 513.

The wall 519 likewise defining the chamber 511 is fixedly connected by a welded connection 520 to the wall 513. The additional wall 519 which in terms of function can be compared with the wall 19 according to Figure 1 is designed

as a double-layered shaped sheet metal body 559. The shaped sheet metal body 559 has two substantially axially aligned arms 559a, 559b. The free end of the radially outer arm 559b is rigidly connected to the wall 513 by the welded connection 520. The radially inner arm 559a has axial noses 519b moulded on to its end areas facing the chamber 511 and these noses form biasing areas for the energy accumulators 509. The axial attachments or noses 519b engage on the end areas of the energy accumulators 509 in the event of relative rotation between the two flywheel masses 502, 503.

The shaped sheet metal part 559 according to Figure 8 thus in practice undertakes both the function of the wall 19 and that of the additional mass 59 according to Figure 1.

The profiled areas or starting gear rings 261, 361, 461, 561 can be formed in the shaped sheet metal part after folding the metal sheet. These profiled areas can be formed by stock-removing work such as eg milling or scraping. The profiled areas 261, 361, 461 and 561 can however also be formed by stamping, thus through a stressing process in the material. Furthermore these profiled areas can be formed by punching. A further possibility of manufacturing profiled areas of this kind consists in cutting these out by means of laser beams.

It can be particularly expedient if the shaped sheet metal parts according to the invention are hardened at least in parts or partially. Thus it can be particularly advantageous if at least in the area of the profiled areas or starting gear rings 261, 361, 461, 561 the corresponding shaped sheet metal parts 260, 360, 460, 560 have a greater hardness than in the remaining areas. Such a partial or local increase in hardness can be achieved for example by inductive hardening or case-hardening. The shaped sheet

metal parts can also be hardened completely.

The invention is not restricted to the embodiments described and illustrated but also embraces variations which can be formed by a combination of individual features and elements described in connection with the various embodiments. The invention also relates quite generally to the production of additional mass bodies from sheet metal material in order to increase the inertia moment of twin-mass flywheels. These mass bodies thereby allow the contour of the twin mass flywheel to adapt to the contours of the installation space available in the best possible way. According to a further idea these additional mass bodies cannot only be made by folding or bending sheet metal but can also be made by winding a sheet metal strip in a ring. The mass bodies can thereby be formed by wound layers wrapped individually on each other or however also by continuous winding as a multi-layered body.

The applicant reserves the right to claim as being essential to the invention further features which up until now have only been disclosed in the description .

PATENT CLAIMS

1. Torsional vibration damping device, more particularly for installation between an internal combustion engine and a gearbox, with an input part and an output part between which a damping device is provided in the torque transfer path, characterised in that the device has a fitted flywheel mass formed by a sheet metal body wherein the sheet metal of the body is folded round at least once over practically a complete circular circumference so that sections of the sheet metal body exist which have at least two directly adjoining sheet metal layers.

2. Vibration damping device according to claim 1, characterised in that the sheet metal body is supported by the input part.

3. Vibration damping device according to claim 1 or 2 characterised in that the sheet metal body is formed from an originally flat disc-like sheet metal blank.

4. Vibration damping device according to one of claims 1 to 3 characterised in that the at least double-layered sheet metal body sections have a smaller radial extension than the sheet metal body and are provided radially outside on same.

5. Vibration damping device according to one of claims 3 or 4 characterised in that the multi-layered sheet metal body sections are formed by radially folding over the radially outer areas of the original sheet metal blank.

6. Vibration damping device according to one of claims 1 to 5 characterised in that the individual layers of the sheet metal body sections adjoin one another.

7. Vibration damping device according to one of claims 1 to 6 characterised in that the individual layers of the sheet metal body sections run substantially radially.

8. Vibration damping device according to one of claims 1 to 6 characterised in that the individual layers of the sheet metal body sections run substantially axially.

9. Vibration damping device according to one of claims 1 to 8 which is set in a housing characterised in that at least the folded areas of the sheet metal body are substantially adapted to the contours of the boundary faces of the housing.

10. Vibration damping device according to one of claims 1 to 9 wherein the input part is formed by a first flywheel element which can be coupled with the internal combustion engine and the output part is formed by a second flywheel element which can be connected to the gearbox wherein both flywheel elements can be rotated relative to each other through a bearing.

11. Vibration damping device according to claim 10 characterised in that the first flywheel element defines a chamber which is filled at least partially with a viscous medium and houses the springs of the damping device.

12. Vibration damping device according to claim 10 or 11 characterised in that the sheet metal body extends practically over the entire radial extension of the first flywheel mass and is supported by the first flywheel mass on the side of the latter facing the internal combustion engine.

13. Vibration damping device according to one of claims 11

or 12 characterised in that the folded-round areas of the sheet metal body are provided at least approximately radially level with the springs of the damping device.

14. Vibration damping device according to one of claims 10 to 13 characterised in that the folded-round areas of the sheet metal body are facing the first flywheel mass.

15. Vibration damping device according to one of claims 10 to 14 characterised in that the sheet metal body has radially inwards recesses which align with the screw bores for holding the screws for fixing the first flywheel element on the output shaft of the internal combustion engine.

16. Vibration damping device according to one of claims 10 to 15 characterised in that radially middle areas of the sheet metal body have apertures which at least substantially coincide with the recesses in the wall of the first flywheel element adjoining the sheet metal body.

17. Vibration damping device according to one of claims 10 to 16 characterised in that the sheet metal body substantially follows the adjoining contours of the first flywheel element.

18. Vibration damping device according to one of claims 10 to 17 characterised in that the sheet metal body is formed like a plate in that the at least double-layered ring-like radially outer sheet metal body section is off-set axially from the ring-like centre section in the direction of the internal combustion engine.

19. Vibration damping device according to claim 18 characterised in that the axially off-set sheet metal body section has at least one radial opening which is formed by

cutting free the layer which has not been folded round.

20. Vibration damping device according to claim 19 characterised in that the radially inwardly folded layer is set back in the area of the free cut section axially in the direction of the disc-like inner area.

21. Vibration damping device according to one of claims 10 to 20 characterised in that the sheet metal layers of the one-piece sheet metal body run axially, the sheet metal body is fixed radially outside on the first flywheel element, extends axially over the second flywheel element and encloses same.

22. Vibration damping device according to one of claims 10 to 20 characterised in that the first flywheel element has a first wall which is connectable with the internal combustion engine, runs substantially radially and supports radially on the outside a second wall which together with the first wall defines the chamber and furthermore extends radially inwards in the axial structural space between the first wall and the second flywheel element to form a free space which is set between the wall and the second flywheel element radially inside the energy accumulator of the damping device wherein a sheet metal body connected with the second wall is housed in this free space.

23. Torsional vibration damping device substantially as herein described with reference to the accompanying drawings.

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Examiner's report to the Comptroller under Section 17 - 28 -
(The Search report)

·levant Technical Fields (i) UK Cl (Ed.M) F2U, F2T (ii) Int Cl (Ed.5) F16F 15/12, 15/30 **Databases** (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASES: WPI	Application number GB 9408875.4 Search Examiner T S SUTHERLAND Date of completion of Search 13 JUNE 1994 Documents considered relevant following a search in respect of Claims :- 1-23

Categories of documents

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&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2219647 A (LUK LAMELLEN) Figures 1 to 13	1,2
Y	GB 1559314 (HONDA) Figure 2	1,2

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